

Hasan Oğuz
Selami Akkuş
Serdar Tarhan
Saim Açıkgözoğlu
Memduh Kerman

Measurement of spinal canal diameters in young subjects with lumbosacral transitional vertebra

Received: 24 October 2000
Revised: 18 June 2001
Accepted: 29 June 2001
Published online: 31 July 2001
© Springer-Verlag 2001

H. Oğuz
Department of Physical Medicine
and Rehabilitation, School of Medicine,
University of Selçuk, Konya, Turkey

S. Akkuş
Department of Physical Medicine
and Rehabilitation, School of Medicine,
University of Süleyman Demirel,
Isparta, Turkey

S. Tarhan
Department of Radiology,
School of Medicine,
University of Celal Bayar, Manisa, Turkey

S. Açıkgözoğlu
Department of Radiology,
School of Medicine, University of Selçuk,
Konya, Turkey

M. Kerman
Department of Neurosurgery,
School of Medicine,
University of Süleyman Demirel,
Isparta, Turkey

S. Akkuş (✉)
Hızırbey mah. 1523 Sok. Mutlu apt.
No. 8/5 TR-32040, Isparta, Turkey
e-mail: selamiakkus@hotmail.com,
Tel.: +90-246-2326656/120,
Fax: +90-246-2329422

Abstract Despite the high prevalence of lumbosacral transitional vertebra (LSTV), little is known about the biomechanics of this condition. In addition, as previous studies have focused solely on symptomatic and elderly LSTV patients, the relationship between LSTV and congenital or developmental spinal stenosis remains uncertain. In the present study, the spinal canal diameters were measured in young subjects in whom degenerative changes have not yet become significant. Seventeen young adults with LSTV and 24 normal controls were included in this study. The spinal canal sagittal diameter, interpedicular distance, interfacet distance and lateral recess diameter were measured using CT scans. There was no significant difference in the measured values between the two groups. In conclusion, the results indicate that there is no relationship between LSTV and a congenitally narrower canal.

Keywords Transitional vertebra · Spinal stenosis · Spine CT

Introduction

Lumbosacral transitional vertebrae (LSTV) are common congenital anomalies, with a reported prevalence of 3–21%

[18]. Despite the frequent occurrence of these vertebrae, little is known concerning their pathophysiology or biomechanics [4]. The association of back pain with LSTV was first described by Bertolotti in 1917 [4], but the causal role of LSTV in low back pain (LBP) syndrome is

controversial. Some authors [2, 3, 4, 7, 20] have argued that transitional vertebra is a source of trouble; however, many others disagree [10, 15, 16].

It is not clear that lumbosacral congenital anomalies, including LSTV, are a cause of primary back pain, or that they produce a predisposition to other pathology. The results of the few studies published on this subject showed no higher incidence of structural problems in patients with LSTV than in those without such vertebrae [1, 4, 19]. However, it has been suggested that there is an increase in degenerative changes such as disc protrusion, facet degeneration, nerve root canal stenosis and degenerative spondylolisthesis just above transitional lumbosacral segments [4, 11, 18].

A small vertebral canal is undoubtedly a significant factor for many patients with LBP [12]. The early papers of Verbiest [17] and other investigators confirmed that a variety of back pain syndromes are related to spinal pathologic conditions in the presence of an already small canal [5, 6, 13, 17, 21]. It is now known that a disc prolapse into a restricted space can produce more troublesome symptoms than does a protrusion into a wider canal [11]. In a previous study, Elster [4] demonstrated that central and lateral spinal stenosis is much more common at or near the interspace above the transitional vertebra. In contrast, a recent study conducted by Vergauwen et al. [18], in which they measured the spinal canal diameters in adult patients with LBP and with or without LSTV on computed tomographic (CT) scan, found no significant difference in the distribution of spinal stenosis between the two groups.

In this study, we aimed to throw light on this subject by measuring lumbosacral canal diameters in young people in whom degenerative changes have not yet become significant. To our knowledge, this is the first study to measure spinal canal diameters in young subjects with LSTV.

Materials and methods

The 100 subjects participating in the study were volunteer university students (age range 17–20 years, mean age 18.43 ± 0.81). To maintain homogeneity of the sample, only female subjects were studied and none of them was symptomatic for LBP. Plain anteroposterior radiographs of the lumbosacral spine were taken, to determine those with congenital anomalies. The radiographs were all evaluated by the same observer (S.A.) for presence of LSTV.

LSTV was defined on the basis of two criteria. First, at least one transverse process had to fuse or articulate with the first contiguous sacral segment. Second, an intervertebral disc space, even vestigial, must be presented caudal to the transitional vertebra. The terms “lumbarization” and “sacralization” were avoided [18].

LSTV was established in 17 of 100 participants. Twenty-four of the remaining 83 subjects were selected randomly as controls, in whom there was no LSTV or other congenital anomaly. The incidence of lumbar disc herniation increases at the level just above the transitional vertebra, and the most common levels of lumbar spinal stenosis are L4-5 and L3-4 [11, 14]. Therefore, CT studies were performed in subjects with LSTV and controls at the L4 and L5 levels, and the level of the transitional vertebra was accepted as L5.

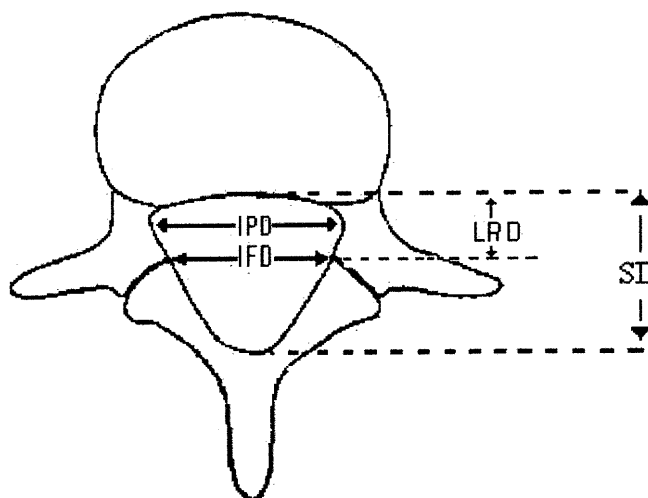


Fig. 1 Measurement of the lumbar spinal canal (*SD* sagittal diameter, *IPD* interpedicular distance, *IFD* interfacet distance, *LRD* lateral recess diameter)

CT scans were performed on a 600 XS scanner (Toshiba, Japan, 400 mA/s, 120 kV). The standardized CT protocol involved examination of the L4 and L5 vertebrae in the LSTV and control group. Axial sections were taken parallel to disc interspaces, as determined from a scout radiograph. Slice thickness was 5 mm, with increments of 4 mm. All measurements were taken directly from the CT video image display, using standard operator-controlled functions. The following measurements were made (Fig. 1):

1. Sagittal diameter (SD): the greatest distance between the anterior and posterior margins of the canal at the midline
2. Interpedicular distance (IPD): the distance between the medial borders of the pedicles
3. Interfacet distance (IFD): the distance between the anteromedial points of the facet joints
4. Lateral recess diameter (LRD): the distance between the posterior aspect of the vertebral body and the anteromedial point of the facet joint [8]

All CT scan measurements were made by one observer (S.T.).

Statistical comparison between the groups was performed using an unpaired Student's *t*-test. Statistical significance was attributed to *P*-values less than 0.05.

Results

LSTV was present in 17 of 100 subjects (17%). All subjects in this group were women, ranging in age from 17 to 20 years, with a mean age of 18.5 years. The control

Table 1 Characteristics of all subjects (*LSTV* lumbosacral transitional vertebra)

	Without LSTV	With LSTV	Significance
Age (yrs)	18.21 ± 0.79	18.88 ± 0.92	NS
Weight (kg)	53.58 ± 5.50	54.86 ± 5.90	NS
Height (cm)	161.75 ± 4.18	160.66 ± 5.57	NS

NS No significant difference between the two groups

group comprised 24 women without an LSTV, ranging in age from 17 to 19 years, with a mean age of 18.3 years.

Demographic data of those with and without an LSTV are presented in Table 1. There were no significant differences in mean age, weight or height ($P>0.05$). The comparison of canal diameters measured by CT in lumbar spine with and without LSTV is presented in Table 2. As shown in the table, although there was a slight difference in the sagittal diameters at the L5 level between the LSTV and the control group (Fig. 2), there was no significant difference in the measured values between the two groups ($P>0.05$).

Table 2 The values of spinal canal diameters in subjects with and without LSTV

Diameters (mm)	Without LSTV (n=24)	With LSTV (n=17)	Significance
L4			
Sagittal diameter	16.1±2.8	14.8±1.7	NS
Interpedicular distance	24.5±3.4	24.1±3.1	NS
Lateral recess diameter (right)	6.8±1.0	6.3±0.9	NS
Lateral recess diameter (left)	6.9±0.9	6.6±1.3	NS
Interfacet distance	22.7±2.9	21.7±2.8	NS
L5			
Sagittal diameter	16.0±1.9	14.9±1.8	NS
Interpedicular distance	27.4±6.0	28.1±4.5	NS
Lateral recess diameter (right)	6.0±0.4	6.1±1.1	NS
Lateral recess diameter (left)	5.9±1.0	6.0±1.4	NS
Interfacet distance	26.0±4.0	24.0±4.5	NS

NS No significant difference between two groups

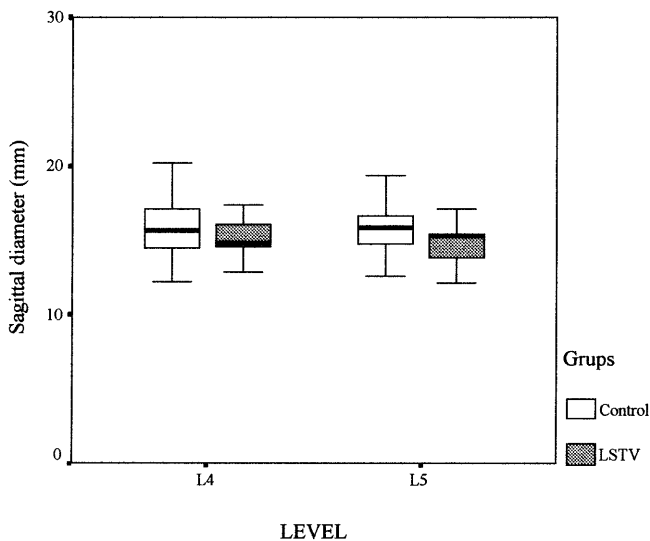


Fig. 2 The sagittal diameters at the L4 and L5 levels. Statistical analysis showed no significant difference comparing sagittal diameters of L4 and L5 in subjects with lumbosacral transitional vertebra and controls

Discussion

Lumbar radiographic abnormalities such as transitional vertebra have been commonly cited as significant findings in patients with low back pain [2, 3, 4, 7, 20]. However, the role of these radiographic abnormalities in the etiology of LBP is unclear [1, 3, 4, 15, 18, 19].

The results of the present study indicate that there is no significant difference in spinal canal diameters at the L4 and L5 levels between subjects with and those without transitional vertebra (Table 2).

Castellvi et al. [1] made the first attempt to define the relationship of LSTV and disc pathology from a radiologic perspective. They showed that extradural myelographic defects consistent with disc herniations were present with increased incidence above transitional vertebrae. However, their results were based on myelography, a modality considerably less sensitive than CT in assessing the full spectrum of spinal pathology. They also did not consider the incidence of spinal stenosis or other nondiscogenic structural problems as etiologies for pain in these patients [1].

A review of the literature revealed two studies [4, 18] dealing with the association between spinal stenosis and LSTV. These studies differ considerably from the current study with regard to design and study population. Therefore, a direct comparison among studies is difficult.

Elster [4] postulated that hypermobility at the interspace above the transitional vertebra constitutes a much higher risk for degenerative disc and facet joint changes than LSTV, resulting in a possible narrowing of the spinal canal or neural foramina. In a recent study, Vergauwen et al. [18] also suggested that the greater incidence of degeneration could be attributed to the relative hypermobility of the disc above an LSTV. However, in our previous study we did not find any significant effect of congenital anomalies such as transitional vertebra on translatory and angulatory motion by dynamic radiographic study [9].

Vergauwen et al. [18] also reported that distribution of degenerative changes occurred more often in patients with LSTV than in those without, but for spinal canal stenosis they could not find a statistically significant difference between the two groups. However, their study population included older patients with low back pain (mean age 47.3 years).

Conclusions

In the present study, we measured lumbosacral canal diameters in young people in whom degenerative changes had not yet become significant. We did not find any association between spinal stenosis and LSTV. The data from this preliminary study suggest that there is no relationship between LSTV and congenital spinal stenosis.

Acknowledgements We express our thanks to Dr. Said Bodur for his statistical assistance.

References

1. Castellvi AE, Goldstein LA, Chan DBK (1984) Lumbosacral transitional vertebrae and their relationship with lumbar extradural defects. *Spine* 9: 493–495
2. Dai L (1999). Lumbosacral transitional vertebrae and low back pain. *Bull Hosp Joint Dis* 58:191–193
3. De Palma AF, Rothman RH (1970). The intervertebral disc. Congenital and acquired abnormalities of the lumbar spine: their relation to back or back and leg pain. WB Saunders, Philadelphia, pp 249–268
4. Elster AD (1989) Bertolotti's syndrome revisited. Transitional vertebrae of the lumbar spine. *Spine* 14:1373–1377
5. Epstein JA, Epstein BS, Levine I (1982). Nerve root compression associated with narrowing of the lumbar spinal canal. *J Neurol Neurosurg Psychiatry* 25:165–176
6. Heliovaara M, Vanharanta H, Korpi J, Troup JDG (1986) Herniated lumbar disc syndrome and vertebral canals. *Spine* 11:433–435
7. Kim NH, Suk KS (1997) The role of transitional vertebrae in spondylolysis and spondylolytic spondylolisthesis. *Bull Hosp Joint Dis* 56:161–166
8. Lee BCP, Kazam E, Newman AD (1978) Computed tomography of the spine and spinal cord. *Radiology* 128: 95–102
9. Oğuz H, Arslan A, Akkuş S, Ödev K, Şimşek I, Kalkan E, Yorulmazoğlu EI (1993) Advanced in low back pain. In: Ernst E, Jayson MIV, Pope MH, Porter RW (eds) *The effect of congenital anomalies on the lumbar spine motion: a dynamic roentgenographic study*. Blackwell MZV, Vienna pp 378–381
10. Pajanen H, Erkintalo M, Kuusela T, Dahlstrom S, Korman M (1989) Magnetic resonance study of disc degeneration in young low back pain patients. *Spine* 14:982–985
11. Porter RW (1996) The lumbar spine. In: Wiesel SW, Weinstein JN, Herkowitz H, Drovak J, Bell G (eds) *Lumbar spinal stenosis: development of the vertebral canal*. WB Saunders, Philadelphia, pp 711–716
12. Porter RW, Bewley B (1994) A ten-year prospective study of vertebral canal size as a predictor of low back pain. *Spine* 19:173–175
13. Porter RW, Hibbert C, Wellman F (1980) Backache and the lumbar spinal canal. *Spine* 8:99–105
14. Sortland O, Magnaes B, Hauge T (1977) Functional myelography with Metrizamide in the diagnosis of lumbar spinal stenosis. *Acta Radiol [Suppl]*: 355:42–54
15. Tini PG, Wieser C, Zinn WM (1977) The transitional vertebra of the lumbosacral spine: its radiological classification, incidence, prevalence, and clinical significance. *Rheumatol Rehabil* 16:180–185
16. Van Tulder MW, Assendelft WJ, Koes BW, Bouter LM (1997) Spinal radiographic findings and nonspecific low back pain. A systematic review of observational studies. *Spine* 22:427–434
17. Verbiest H, (1954) A radicular syndrome from developmental narrowing of the lumbar vertebral canal. *J Bone Joint Surg Br* 36:230–237
18. Vergauwen S, Parizel PM, Van Breusegem L, Van Goethem JW, Nackaerts Y, Van den Hauwe L, De Schepper AM (1997) Distribution and incidence of degenerative spine changes in patients with a lumbo-sacral transitional vertebra. *Eur Spine J* 6:168–172
19. Wigh RE, Anthony HF (1981) Transitional lumbosacral disc. Probability of herniation. *Spine* 6:168–171
20. Wiltse LL (1971) The effect of the common anomalies of the lumbar spine upon disc degeneration and low back pain. *Orthop Clin North Am* 2:569–582
21. Wiston K, Rumbaugh C, Colucci V (1984) The vertebral canals in lumbar disc disease. *Spine* 9:414–417